



## Improving critical thinking skills of high school students through the implementation of mobile-based game applications

 Agus Efendi<sup>1\*</sup>

 Taufiq Subhanul Qodr<sup>2</sup>

<sup>1,2</sup>Educational Technology Program, Sebelas Maret University, Surakarta, Indonesia.

<sup>1</sup>Email: [agusefendi@staff.uns.ac.id](mailto:agusefendi@staff.uns.ac.id)

<sup>2</sup>Email: [taufiqsubhanul@student.uns.ac.id](mailto:taufiqsubhanul@student.uns.ac.id)



(+ Corresponding author)

### ABSTRACT

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This study aimed to identify the effectiveness of Android-based mobile games in helping high school students improve their critical thinking skills. A quantitative research method was used through a quasi-experimental design with pre-test and post-test in both control and experimental classes. Data collection techniques comprised test techniques and the use of tools to obtain data about the critical thinking skills of high school students. The data was then analyzed quantitatively by t-test and n-gain scores. A total of 58 high school students studying the sociology subject participated in this study. The findings show that the use of mobile game-based learning products has a major impact on improving students' critical thinking skills. In addition, based on the findings of this study, it was evident that mobile game-based learning applied to sociology learning was included in the "efficient" category in influencing and enhancing students' critical thinking skills in an effort to build 21st century competence in high school students. Therefore, this research implied that teachers can start utilizing mobile game-based learning products as a medium for learning sociology in high school.

**Contribution/Originality:** This research contributes how teachers cannot confine themselves to the application of smartphones and types of games during the learning process. This study would provide a stimulus to students' critical thinking abilities as it identifies the impact of mobile game based-learning on students' critical thinking skills in learning sociology subjects.

### 1. INTRODUCTION

In the last few years, technology has developed very rapidly, so that its presence requires someone to be able to accept technology in their daily lives. They are required to master many competencies that are relevant to the demands of the times (Dewi, Wardani, Wijayati, & Sumarni, 2019; Shafie, Majid, & Ismail, 2019). The curriculum's implementation and its policies, particularly after the COVID-19 epidemic, where all learning activities have started to use technology, are the only aspects of education that are impacted by the use of technology (Ali & Maksum, 2020; Lassoued, Alhendawi, & Bashitialshaaer, 2020). Using the internet and its devices is only one aspect of an effective information and communication technology (ICT) integration into the teaching and learning process. Students should also receive feedback and reinforcement to develop their competence and digital literacy abilities (Chandrasiri & Weerakoon, 2022; Yacob, 2020). Recently, competency mastery has begun to emphasize issues that are developing globally and internationally. Students need to improve their skills because 21st century skills are

very important for competitiveness. In response to the presence of mastery of these competencies, the government is committed to developing educational programs that can help students acquire 21st century skills (Rokhani & Purnami, 2021), such as: 1) cooperation and collaboration, 2) communication, 3) innovation, 4) critical thinking, 5) information literacy, 6) career development, 7) occupational health and safety, 8) lifelong learning, and 9) entrepreneurship (Boyles, 2012; Ilomäki, Paavola, Lakkala, & Kantosalo, 2016).

According to the learning system, schools must be able to help students develop their talents beyond simply getting them ready for exams and raising their test scores (Kondakci, Beycioglu, Sincar, & Ugurlu, 2017). In order to assist children develop into active thinkers, perceptive and adaptable learners, creative problem solvers, and engaged citizens, and schools should help provide them with the tools they need (Agyei & Agyei, 2021; Al Salman, Alkathiri, & Khaled Bawaneh, 2021). For example, critical thinking abilities that are helpful for students' prospective future growth are significant talents and dispositions that are considered significant for education in the twenty-first century. Every student should acquire critical thinking skills as crucial 21st century competencies to achieve (Yunita & Aufa, 2020). In order to enhance one's cognition with self-awareness and the abilities to use this data to foster creativity and take risks, one must seek, gather, evaluate, analyze, synthesize, and conceptualize information (Abdulah, Mustadi, & Fitriani, 2021). Today, critical thinking is a skill that is in high demand because it is the foundation for examining arguments and developing logical thought patterns (Afandi, Wahyuni, Kristiana, & Putra, 2021; Ismail, Harun, Zakaria, & Salleh, 2018). Long-term gains from critical thinking include helping students manage their learning processes and enabling people to make creative contributions to their chosen fields of endeavor (Saputra, Joyoatmojo, Wardani, & Sangka, 2019). According to past research, students' educational experiences at all educational levels must be founded on critical thinking. The correct character (disposition) must be introduced in the beginning of critical thinking before it can be developed (Mutakinati, Anwari, & Kumano, 2018; Seibert, 2021). In other words, by providing pupils with critical thinking abilities, teachers can help them prepare for the future. While addressing problems, assessing presumptions, providing justification, evaluating, conducting investigations, and making judgments, critical thinking is involved (Rahmi, Alberida, & Astuti, 2019). Searching, analyzing, and evaluating information are very crucial skills in any decision-making process, and critical thinkers always look for and express the connections between the issues at hand and other pertinent concerns or experiences (Changwong, Sukkamart, & Sisan, 2018; Saiful, Utaya, Bachri, Sumarmi, & Susilo, 2020). For a structured method of problem-solving, too, critical thinking incorporates mental activity and abilities to formulate problems, present arguments, perform deductions and inductions, evaluate, and make conclusions (Yean, 2019). According to Bloom, there are six categories of thinking skills: remembering, understanding, applying, analyzing, evaluating, and creating (Krathwohl, 2002). The widespread consensus is that critical thinking abilities are becoming increasingly crucial for success in modern life as the rate of change, complexity, and interdependence keeps increasing (Sert & Boynueğri, 2016). People are increasingly expected to make reasonable decisions based on critical/evaluative thinking as the world develops rather than simply following orders (Tom & Stalker, 1979). Students must therefore be prepared to think critically in both the contexts of school and daily life. This includes being able to raise doubts, analyze issues, and consider alternatives.

The reality, however, speaks differently. According to the findings of surveying students at Public senior high school (SMA N) 1 Karangnom and Public senior high school (SMA N) 1 Jatinom, instructional materials that encourage critical thought are still not used in sociology classes. A total of 149 people responded, and 56% of them said that lectures were still utilized to teach abstract topics in sociology courses. Since 96% of students agree that sociology learning uses gaming media to make it simpler to understand sociological concepts, students in such online learning environments need learning materials that are interactive and packaged through engaging games. Together with this, students frequently engage in daily activities that are influenced by cellphones (Aurum & Surjono, 2021). 63% of all respondents indicated that they use their smartphones for more than five hours each day. Naturally, using game media on cellphones will be successful. The sociology teacher at Public senior high school

(SMA N) 1 Karanganyam's comment further emphasizes the need for interactive media to present research technique content since students genuinely need to go into the field but are unable to do so due to the Covid-19 outbreak. The instructor solely clarifies through video demonstrations and talks. He reveals that learning media were needed that were able to visualize social research in a simple way, so that students could practice and understand sociological concepts through experimental projects. Meanwhile, the teacher of Public senior high school (SMA N) 1 Jatimom revealed that students do not have sensitivity to sociology material that requires critical thinking, so various activities that can stimulate deep thinking are urgently needed. One inventive application of technology to assist the process of learning and instruction is the packaging of educational media in the form of games (Emerson, Cloude, Azevedo, & Lester, 2020). Media that can display social research is excellent for supporting experimental operations in sociology classes. One possibility is to use game-based learning that may be used on cellphones to visualize experimental actions in sociology disciplines (Hwang, Hung, & Chen, 2014; Liu, Shaikh, & Gazizova, 2020).

Students have the chance to alter, practice, and absorb concepts and understanding through mobile game-based learning (Aurum & Surjono, 2021). One of the key elements in the learning experience is having fun (Singh, 2016). Mobile game-based are being employed for more than just entertaining activities; they may also serve as a means of disseminating information or instructional materials. The creation of applications that take the shape of games is continuing to see innovation (Hartt, Hosseini, & Mostafapour, 2020). Mobile game-based as instructional media play a variety of supportive roles for learning (Coleman & Money, 2020; Hartt et al., 2020). Six characteristics define educational games as learning tools: fantasy, rules, and objectives; sensory stimulation; challenge; mystery; and control (Sulistio & Qohar, 2020; Zeng, Zhou, Hong, Li, & Xu, 2020). The advantages of mobile game-based education can serve as a substitute for social research assignments in sociology courses. However, with a mobile game-based learning design, the students are more flexible and the teacher will be able to control it more easily without involving significant risks. Social research activities are typically conducted in the field and processed through a sociology laboratory, which takes quite a bit of time for students.

Using mobile game-based learning for instruction Sociology is in line with cognitive theory, which focuses on how information is acquired, organized, stored, and processed by the mind as well as how student learning processes are conceptualized. Playing research simulations can improve critical thinking abilities since they place a premium on problem-solving abilities (Cromley & Lawrence, 2018; Simanjuntak, Hutahaean, Marpaung, & Ramadhani, 2021). The best technique to develop students' critical thinking abilities is through the use of mobile games for learning sociology. Critical thinking skills are the ability to think critically based on personal experience to make decisions and solve problems.

As we enter the fourth industrial revolution, which is characterized by the use and dissemination of information through digital networks and devices connected to the internet, this situation offers great opportunity for people to use digital devices and networks as well as internet support in daily interactions. - Although the general public, including students, can quickly access any information or subject matter, an educator is required to be able to give filters for information and material that are actually needed by pupils (Sari et al., 2020). It has been demonstrated theoretically and experimentally that learning that uses technology as a learning medium, in this case mobile game-based learning, improves students' learning capacities and academic accomplishment in both the affective, psychomotor, and cognitive domains (Nugraha & Wahyono, 2019; Nusir, Alsmadi, Al-Kabi, & Sharadgah, 2013; Nehir Sert & Boynuegri, 2017; Yue, 2017), increase student motivation (Irawan & Suryo, 2017; Li & Ren, 2018), student learning outcomes (Kareem, 2018; Manurung & Panggabean, 2020).

Even able to develop students' character (Komalasari & Saripudin, 2018; Septiani & Rejekiningsih, 2020; Suyantiningsih, Munawaroh, & Rahmadona, 2016). The effectiveness of teaching and learning processes is still largely dependent on the learning tactics employed by teachers; thus far, technology has mostly assisted teachers in facilitating effective teaching. For this reason, teachers can benefit from technology by using games that are tailored to the needs of their students and can be played on smartphones. These games have been shown by study to

enhance students' critical thinking abilities (Harris, Regan, Schueler, & Fields, 2020; Karma, Darma, & Santiana, 2021; Shute & Ke, 2012).

Playing a smartphone game presumes that players do so voluntarily and that they are not just doing it for fun. A desire to develop a skill, communicate socially with other players, and spend time in the selected assessment unit can also be included (Abdul Jabbar & Felicia, 2015; Al Fatta, Maksom, & Zakaria, 2018). Scientific research from several nations indicates that Mobile Game Based-Learning (MGBL) can boost academic performance and be integrated into a variety of themes or disciplines; nevertheless, at the moment, its application is not very common (Fei, Li, & Sun, 2020; Hwang et al., 2014; Tsai, Huang, Hou, Hsu, & Chiou, 2016; Zou, Huang, & Xie, 2021). Therefore, the authors are interested in the academic benefits provided by using the MGBL concept.

Learning with mobile technology allows students to extend their discussion and investigation beyond the classroom setting and take their smartphone with them wherever they go (Zaheer, Butt, Anatolyevna, & Salmani, 2018). With the use of smart phones, students can collaborate on knowledge creation and learning while communicating with a wide range of people. Hence, mobile game-based learning promotes a constructivist approach to learning (Atherton, 2019; Hanif, Asrowi, & Sunardi, 2018; Martín-Gutiérrez, Mora, Añorbe-Díaz, & González-Marrero, 2017), because it provides a learner-centered pedagogy (Coleman & Money, 2020) and can enhance student self-directed learning towards a goal (Li & Zheng, 2018; Nehir Sert & Boynuegri, 2017). Currently, the growth of smartphones is fueling the exponential growth of mobile applications, particularly those geared toward entertainment (Drigas, Dede, & Dedes, 2020; Kreijns, Vermeulen, Van Acker, & Van Buuren, 2014; Melumad & Pham, 2020; Sari, Rejekiningsih, & Muchtarom, 2020). According to other surveys, students spend a lot of time utilizing smartphones and playing video games for personal reasons. Considering the significance of video games in young people's life (Aurum & Surjono, 2021).

In the context of using technology and learning to use smartphones, several previous studies have been conducted. The outcomes of a study to see how to use a virtual lab affected students' capacity for problem-solving when learning about electricity. According to the research, employing a virtual lab has a more significant impact on students' ability to solve electrical-related problems than using traditional teaching techniques (Prasetyo, Kristiyanto, & Doewes, 2019). Other research demonstrates that smartphones can be used as a tool for running learning media in the form of quiz games. These games are specifically designed for active learning as one of the supports, and students feel happy and motivated to learn there, but the subject matter is still only economics (Wibawa, Astuti, & Pangestu, 2019). Virtual learning labs that students may access using cellphones have also been successfully integrated by other study (Suryanda, Sartono, & Sa'diyah, 2019). In keeping with that, another research has also demonstrated a considerably higher rating for academic accomplishment motivation in the experimental group using mobile game-based learning than in the control group. The study's findings also indicate that computer game - based learning affect primary school pupils' motivation for academic accomplishment. From implementation, design, and research perspectives, the outcomes may be favorable for academics, game designers, and instructional designers (Partovi & Razavi, 2019).

As with some of the relevant research studies above, it appears that there is no research that aims to utilize mobile game-based learning for sociology learning. More development and utilization research were found regarding the use of virtual laboratories in natural science subjects, and for social learning it was only limited to social laboratories which did not have a practice simulation function for simple research. Also, the creation and use of digital media, which is restricted to the creation of graphic, video, and printed instructional resources, as well as the measuring variables used to ascertain the impact of item use on inspiration and educational outcomes.

A key consideration for educators is to begin adopting and adapting technological advancements as a learning innovation, particularly in sociology education, which has historically tended to be heavily lecture-based. Due to this, students are currently very accustomed to having smartphones in their daily lives, one effort that educators may make is to innovate by employing smartphone applications and learning materials, such as the usage of

Android smartphones, particularly through game applications to promote learning. Hence, using a mobile game-based learning product as a sociology learning medium, this project will attempt to incorporate the use of information and communication technologies into the learning process. This study is based on the premise that various studies have also been able to empirically demonstrate that using mobile games for learning might enhance students' critical thinking abilities on Android-based devices (Lim, 2021; Wardoyo, Satrio, Narmaditya, & Wibowo, 2021). The major goal of this research was to determine whether or not the application of this product throughout the learning process can make an impact. It also aimed to assess the efficacy of employing mobile game-based learning products. This research is focused on the problem of improving students' critical thinking skills by utilizing game-based learning. The straightforward goal of this study is to provide answers for two research questions, including: 1) Can using mobile game-based learning materials improve students' critical thinking abilities? and 2) How effective are mobile game-based learning tools at enhancing students' capacity for critical thinking?

**2. METHOD**

The App mobile game-based learning product has undergone a feasibility test stage by media experts, material experts, and teachers; overall, the outcomes of the due diligence have been placed in the appropriate category to be used as means of learning to teach a subject like sociology. In this study, a quantitative technique was adopted to evaluate the product's effectiveness and its impact on students' capacity for critical thinking (McKim, 2017). The purpose of this effectiveness test is to evaluate the performance of the proposed product. The research method employed was the experimental method, a form of quantitative methodology, with a semi model and a nonequivalent control group design (Silalahi, 2015).

58 pupils made up the research's overall sample, which was chosen using the cluster sampling method (Arikunto, 2010), 29 experimental group and 29 in control group. The experimental group's findings were compared to those of the control group in this research design. The control group is a group that does not apply Android-based mobile game-based learning during the learning process, while the experimental group is a group that applies Android-based mobile games during learning activities. through learning activities utilizing these tools. As an example, consider the experimental research's design as follows.

Table 1 Experimental design to improve students' critical thinking skills.

**Table 1. Non - Experimental and control group design.**

Group	Activity		
Experimental group	O <sub>1</sub>	X <sub>1</sub>	O <sub>2</sub>
Control group	O <sub>3</sub>	X <sub>2</sub>	O <sub>4</sub>

Source: Yulianci, Nurjumati, and Adiansha (2021).

Explanation:

- O1 : Experimental group pretest.
- O3 : Control group pretest.
- O2 : Experimental group posttest.
- O4 : Posttest control group.
- X1 : Treatment uses virtual reality media.
- X2 : Not using virtual reality media.

The test was employed as a tool in this study to acquire data regarding high school students' critical thinking abilities. Researchers modified a number of previously conducted, pertinent studies to create this instrument (Fajari, 2021; Hadi & Junaidi, 2017; Supandi & Senam, 2019). The following are the instrument grids used in this study.

Table 2 presents instrument grid for students' critical thinking ability tests.

**Table 2.** Student critical thinking ability instrument lattice.

No.	Indicator	Number of items
1.	Gives a simple explanation	4
2.	Building basic skills	4
3.	Give conclusion	3
4.	Provide opinion and explanation	5
5.	Interact with others systematically	4
	Total	20

The 25 items assessed were found to have 20 valid items and 5 invalid items based on the results of the instrument validity test performed using the Statistical Package for the Social Sciences (SPSS) 25 processing tool. Table 3 displays the outcomes of the instrument reliability test using the Cronbach alpha test.

**Table 3.** Cronbach's alpha reliability test results.

Cronbach's alpha	No of items
0.870	20

Table 3 shows that the instrument used in this investigation was valid if  $r\text{-count} > r\text{-table}$ , or  $0.870 > 0.549$ , even though the  $r\text{-table}$  for a sample size of 19 students ( $N = 19$ ) is 0.549. This shows that the things given to students are considered reliable as a means of collecting data.

The independent sample t-test method was used to assess the usefulness of the data collected from the results of the pre-test and post-test of students in each group. In addition, this test method was able to determine and respond to research hypotheses (Khatri, 2020). The research hypothesis was as follows:

If the value of Sig. (2-tailed)  $< 0.05$ , then  $H_0$  is rejected and  $H_a$  is accepted.

If the value of Sig. (2-tailed)  $> 0.05$ , then  $H_0$  is accepted and  $H_a$  is rejected.

With the formulation of the hypothesis is:

$H_0$ : There is no difference in the average pre-test and post-test results.

$H_a$ : There is a difference in the average results of the pre-test and post-test.

Further data analysis aims to measure the level of effectiveness of learning products based on Android-based mobile games used during the learning process using the N-Gain Score test.

The Gain Test (N-Gain), which is the follow-up test used to assess product performance, must meet the following standards to be effective.

Table 4 N-Gain category for the basis of Product Effectiveness assessment.

**Table 4.** N-gain category (%).

Percentage (%)	Category
$< 40$	Ineffective
40 – 55	Less effective
56 – 75	Effective enough
$> 76$	Effective

Source: Wirjawan, Pratama, Pratidhina, Wijaya, and Untung (2020).

### 3. RESULTS AND DISCUSSION

#### 3.1. Results

Items that are created and given a suitable name are integrated into the teaching and learning process. In order to compare the final outcomes of students' critical thinking abilities and determine whether the developed product is sufficient to contribute or not to the final outcomes of student competencies, only the experimental class used android-based learning products during learning activities. The results of the data collected throughout the testing procedure were first assessed to establish the homogeneity and normality of the data before conducting an

investigation of the influence of mobile games-based learning products. The outcomes of homogeneity and normalcy tests are as follows:

**Table 5. Normality test results.**

Variable	Class	Shapiro-Wilk		
		Statistic	Df	Sig.
Critical thinking skills	Pre-test experiment	0.957	30	0.267
	Post-test experiment	0.895	30	0.051
	Pre-test control	0.974	30	0.662
	Post-test control	0.933	30	0.058

This study adopts a decision-making method based on the Shapiro-Wilk theory. The Shapiro-Wilk test is recommended for data collection with fewer than 50 people (N 50). If the significance level is greater than 0.05, the data is considered to be regularly distributed (sig. > 0.05). Based on Table 5, it was identified that the learning outcomes of the experimental class and the control class were tested for normality and the results were sig. from  $0.267 > 0.05$ . These findings indicate that the experimental class and control class data are regularly distributed. Meanwhile, the homogeneity test findings are detailed in the table.

**Table 6. Homogeneity test results.**

Critical thinking skills	Levene statistic	Df1	Df2	Sig.
Based on mean	2.591	1	58	0.113
Based on median	2.017	1	58	0.161

According to the Table 6, the variation of critical thinking abilities in the experimental class and control class is homogeneous, as indicated by the significance of homogeneity based on the mean being 0.113 (>0.05).

The data was then examined for its impact using an independent t-test after passing the prerequisite test and it was determined that the data acquired was included in the Normal category and the variance of the study sample was included in the Homogeneous category. Table 7 displays the outcomes of tests using mobile game-based learning devices for sociology education.

**Table 7. Acquisition of independent t - test results.**

Results of students' critical thinking ability	t-test for equality of means						
	t	Df	Sig. (2-tailed)	Mean diff	Std. error Diff	95% Confidence interval of the difference	
						Lower	Upper
Equal variances assumed	8.857	58	0.000	17.00	1.919	13.158	20.842
Equal variances not assumed	8.857	58	0.000	17.00	1.919	13.151	20.849

Referring to the test results in Table 7, it was identified that the average learning outcomes between the experimental group and the control group had a significant difference, according to the results of the independent sample t-test analysis which yielded a value of  $0.00 < 0.005$ . This result would be the basis for decision making which means that  $H_0$  is rejected and  $H_a$  is accepted. Based on this, it can be said that there is a significant (actual) difference between the average critical thinking skills of students in the experimental class and the control class, where the experimental class consists of students who use i.e Android game-based learning products to complete their learning process and the control class consists of students who have completed the learning process by using other media. The results of the influence test and hypothesis decision making show that the product developed can improve students' critical thinking skills. Subsequent tests are aimed at becoming able to determine the level of effectiveness of mobile-based game learning media products by using N-Gain score analysis. Thus, the results of the

Gain Score statistical test which was carried out using the information on the results of the students' critical thinking tests in the experimental class and the control class yielded the results presented in Table 8.

**Table 8.** Gain score test results (N-Gain).

Experiment class N-Gain score (%)		Control class N-Gain score (%)	
Mean	81.7	Mean	47.7
Max	100	Max	100
Min	40	Min	40

According to the Table 8 N-Gain test calculations, the average N-Gain value for the Experiment class is 81.7%, falling under the effective category. The average N-gain score for the control class, on the other hand, was 47.7%, placing it in the less efficient category. Consequently, it can be said that using media in a mobile game-based learning style is helpful at enhancing students' critical thinking abilities.

#### 4. DISCUSSION

Nowadays, it has been demonstrated that using digital teaching resources in a variety of formats, such as e-modules that are used in a variety of disciplines, can improve students' academic progress (Budiaman, Komarudin, Nuruddin, & Kustandi, 2021). According to the findings of studies carried out by Latifah, Ashari, and Kurniawan (2020), one of the innovations in science education can be accomplished through the creation and application of digital teaching resources packaged in an electronic module format. This product has been successful in obtaining expert evaluation results in accordance with standards for use during the learning process, and in its application, it has been demonstrated to be able to enhance students' critical thinking skills at the upper secondary education level. Resita and Ertikanto (2018) also succeeded in demonstrating that electronic teaching modules in the form of digital teaching materials were able to improve students' understanding of abstract material. The factors mentioned as contributing to this were that the designs and components contained in electronic module products consisted of text, images, symbols, videos, and animated representations, where together some of these components tend to make it easier for students to understand abstract material.

It is necessary to emphasize that the learning product in the form of digital teaching materials is excellent and deserving of being considered innovative, given that during the development process it was tailored to the needs of the field. Some of the main advantages and benefits that students will receive if using this product include promoting independent learning, the format for presenting the material attractive and interesting, and friendly adaptive to the development of information (Alfan, Khasairi, Nurhidayati, & Maziyah, 2021; Syahputra & Maksum, 2020). This will obviously alter if the only teaching resources used are still printed materials. When used to help the learning process, media concepts and advantages cannot be isolated from the outcomes of developing critical thinking skills (Suparno, 2017; Syawaludin & Rintayati, 2019). As we all know, teachers can utilize media as a tool to process, collect, and transmit information from one person to another who will be receiving it, in this case students, with the hopes that messages in the form of material will be easily comprehended by pupils (Indartiwi, Wulandari, & Novela, 2020). Mobile game-based learning is a gaming platform built for educational activities, where the subject matter is packaged and tailored to the needs of the students in order to make the learning process more engaging. Applications that may operate on mobile devices, such as smartphones, are referred to as "mobile" in this context (Wirjawan et al., 2020). Mobile game-based learning is a tangible example of a paradigm change in education that combines technology with enjoyable learning (Marta, 2019; Noroozi, Dehghanzadeh, & Talae, 2020). Since both students and teachers are presently acclimated to using cellphones, this can undoubtedly serve as the foundation for advancement and innovation that can be included into educational activities (Melumad & Pham, 2020). According to study done by Puritat (2019) demonstrates that an effective learning process for the digital literacy generation is one that is interactive, enjoyable, and challenging. This is because, in the age of globalization

and information, students need to be able to take control of their learning and develop a variety of skills that will enable them to find, interpret, evaluate, and use information as well as come up with original ideas to form opinions about decisions. This is of course in line with research findings, which with the presence of mobile learning can have a significant impact on improving students' critical thinking skills, it is proven that one of the characteristics of fun game media can make learning material more interactive and easier for students to understand.

The supporting elements and uses of a learning medium, namely a focus aid, cannot be isolated from the viability of the designed mobile game-based learning product. According to Gagne, there are nine actions (nine events of instruction) that should be taken into account in the learning process, one of which is gaining or focusing attention (Sari et al., 2020). Using learning media, turning up the volume while explaining material, using body language, turning up the volume when e (Suparno, 2017) explaining with gestures, and letting students know the key points of the meeting or the material are some techniques educators can use to get students' attention during the learning process (Anglin & Dick, 2003; Warsita, 2018). This study's drawbacks include the fact that it is currently just focused on students' critical thinking abilities. While this study still tends to be general in nature by only using a few indicators of critical thinking abilities that have been proposed by various experts and previous researchers, there are many indicators and aspects that influence and can be used as a reference for the development of research instruments to measure students' critical thinking skills. Beyond that, a variety of other elements, of which the educational aspect is but one, affect and contribute to the effect of improving pupils' critical thinking abilities. In order to effectively test students' critical thinking abilities and employ unambiguous measurement indications, it is crucial to pay attention to other elements that affect students' critical thinking abilities.

## 5. CONCLUSION AND RECOMMENDATIONS

It is important to optimize and support the development and learning styles of children whose learning preferences have changed as a result of the use mobile game-based learning. The findings of this study demonstrate that using an Android-based smartphone can be advantageous for learning as well as communication. The study's findings demonstrated that, after students used Android smartphones for the sociology learning process, game apps on those devices helped to improve their critical thinking abilities.

This study can serve as a starting point for other researchers that wish to examine the impact of critical thinking abilities using stricter or comparable indicators, subject-specifically adapting their application. Apart from the usage of digital learning media, conditioning of other elements that influence students' critical thinking abilities can be an intriguing topic of debate for other researchers to determine which factors primarily influence students' critical thinking skill improvement. In addition, educators and other researchers may think about using comparable items for the teaching and learning process. The first factor to be taken into account is how crucial it is for digital learning materials to play a supportive role in students' ability to master competencies and achieve goals.

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**Transparency:** The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.

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**Authors' Contributions:** Conceptualization, supervision, methodology, investigation, writing - original draft and reviewing, A.E.; conceptualization, methodology, investigation, writing - original draft and editing, T.S.Q. Both authors have read and agreed to the published version of the manuscript.

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